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The Effectiveness of Content Retention when Using a Chromebook™ with a Student on the Autism Spectrum

MaryKay Shropshire
Governors State University

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Abstract

A student identified with Autism participated in a single case design study in which note taking was conducted in traditional and technological (Chromebook™) fashion. Participation is used on the general education curriculum and daily exercises completed in the classroom. This research was completed in two phases with the first phase collecting baseline data to be compared to the second phase of data that was collected during the intervention. Each phase lasted 3 weeks and was carried out in the special education classroom within the student's usual Extended School Year program. This research was conducted for the cumulative project at Governors State University during the summer 2015 semester.

Keywords: Autism spectrum disorders, reading comprehension, technology intervention, handwriting, note taking, Governors State University

Chapter I

Introduction

"There was a time when computers were a luxury item for American schools, but the time has clearly passed" (Bangert-Downs, Kulik, & Kulik, 1985). "Educating all students by today's standards and for tomorrow's living most certainly includes the use of technology" (Martin, n.d.). In 1985, Alfred Bork presented how computers would soon affect education,

> We stand at the beginning of a major revolution in the way people learn. We are moving rapidly toward a future when computers will comprise the dominant delivery system in education for almost all age levels and in most subject areas. Not since the invention of the printing press has a technological device borne such implications for the learning process (as cited in Lowther, Ross, & Morrion, 2003, p 23).

The Individuals with Disabilities Education Act (IDEA) ensures that schools must educate all children with disabilities (ed.gov, 2015). Children with a disability shall receive a free, appropriate public education and must be provided with any and all related services to help that child attain their goals set forth in their Individualized Education Program (IEP) (ed.gov, 2015). As mandated by IDEA, the IEP is a legal document that explains the child's present level of academic achievement and functional performance; a statement of measurable goals; a listing of any and all special education, related services, and supplementary aids and services that will be provided to the child or on behalf of the child; and appropriate accommodations that are necessary (ideapartnership.org, 2015). Each education program document is tailored for that specific student. No two IEPs will be the same; hence the word individualized. Warren Fay and Adrianna Schuler state that "two children, both with the same diagnosis, can act very differently

from one another and have varying skills (14)" (as cited in Buehrly, 2005, p. 69). As a result, teachers have had to adapt their teaching styles to all of the students in their classroom.

Integrating technology into the classroom has been an important issue of the last few decades (Lee, Waxman, Wu, Michko, & Lin, 2013). However, technology can be a challenge to even the most seasoned teacher. In *Beyond Access: The Challenges of Implementing Technology in the English/Language Arts Classroom* article addresses how some teachers refuse to use technology because they don't know how to use it properly or struggle with using technology (Zoch, Belcher, & Myers, 2013). Zoch et al. (2013) research served to educate the teachers about different forms of technology so they could use the technology that they already had in their classroom.

Even though technology can be frustrating for some, technology integration can have many benefits. As noted by Granito (2012), a computer can be a great motivator and educator. "Motivation gets humans going. Motivation arouses interests. Motivation creates the want to achieve a goal. Teachers are always looking to see what motivates their students. Motivation is the key to academic success as well as promoting lifelong learning" (Granito, 2012, p. 2).

"The writing process involves skills in language, organization, motor control and planning, and sensory processing: Four areas that are problematic for many individuals with Autism Spectrum Disorder" (Oehler, 2013). Oehler (2013) goes on to say that motor control difficulties will affect the student's ability to coordinate his/her fine motor skill muscles to hold a pencil and write. Oehler (2013) further states that a student with ASD must use sensory regulation to filter out all of the sights, sounds, smells and movements around him/her to focus on what they are trying to write. Parents and teachers should consider that each of the four areas

involved with writing could be a potential problem area for a student with ASD and should look at ways to help students overcome those deficits.

Statement of the Problem

The problem this study investigated arose from the researcher's observations of students with poor handwriting who tend to have difficulty when taking notes. It was the researcher's hypothesis that this difficulty occurred because these students are focused more on formation of letters, grammar, capitalization, and punctuation instead of on the information they are writing to write to aid them in learning the content material. For this reason, the following question guided this study, "Do students with poor hand writing skills retain more information when using a Chromebook™ while taking notes?"

Temple Grandin explained that "Children with autism have a hard time controlling their hands. They tend to have very bad handwriting, and this can frustrate a child" (Buehrly, 2005). Therefore, within this study, it was predicted, that using a Chromebook™ to take notes can alleviate the need for that student to erase what they have already written and re-write the same information multiple times to improve legibility. Grandin stated that "...the teacher should let the child use a computer to write. This will cause less frustration and more enjoyment while writing" (Buerly, 2005). It also was hypothesized that the target student would retain more of the information as a result of taking notes during class when using the Chromebook™ versus writing class notes in longhand.

Purpose of the Study

The purpose of this study was to show the effect of using Chromebook™ technology on the retention of content information for a high school student within a special education program.

A single case study design was used to investigate this problem. The study took 6 weeks to complete, for both the baseline and the intervention data to be collected.

Question of the Study

This study's question, "Do students with poor hand writing skills retain more information when using a Chromebook™ while taking notes?" was looking for the difference between using technology and not using technology and the effect on student retention. It was hypothesized that using a Chromebook™ could alleviate the need for a student to erase their work and waste valuable time when they could be gathering new information.

Assumptions and Limitations

As within any research there will be limitations. Limitations for this research were the lack of participants, the gender of the student, the technology used, and the experimental research design that was used. This research only looked at one student as opposed to a whole classroom of students. Also, this study looked at a female student, while a male student may produce different results. Schaumburg's research results suggested that the "difference between boys and girls in computer literacy can be leveled out in a laptop program" (2001, p.3). Further, using only Chromebooks™ as a way to increase retention might not be the best way when there are many other forms of technology available to schools and parents. Furthermore, there was no way of judging whether the process of pre-testing could have actually influenced the results because there was no baseline measurement against a student who remained completely untreated.

Significance of the Study

The significance of the study was to understand more about retention and the use of technology. Technology is all around us and schools are recognizing that students are exposed to

all kinds of technology in their everyday lives. In order to keep up with changing times, the schools have broaden their expectations of the classroom and instruction. Additionally, this study's educational significance lies in the contribution of study results to the growing body of literature on computer-aided learning.

Definition of Terms

Autism Spectrum Disorder (ASD). A developmental disability significantly affecting verbal and nonverbal communication and social interaction, generally evident before the age of three and adversely affects a child's educational performance (IDEA, 2015). All children will not have the same characteristics or the same severity. They are characterized as having restricted and repetitive patterns of behavior, interests, or activities (American Speech-Language-Hearing Association, 2015).

Baseline. Initial collection of data before the intervention takes place which serves as a basis for comparison with the subsequently acquired data (Riley-Tillman & Burns, 2009). Initial data that are used to monitor changes or the improvement in an individual performance (rtinetowrk.org, 2015).

Cognitive Disability. Significantly sub average general intellectual functioning that affects a child's education (isbe.net, 2015).

Extended School Year (ESY). A special education program and related services that are provided to a child with a disability beyond the normal school year of the public agency in accordance with the child's IEP. This service is at no cost to the parent. This program is not entitled for a student to learn new information but rather to provide practice to maintain previously acquired or learned skills (isbe.net, 2015).

Individualized Education Program (IEP). A written statement for each child with a disability that is developed, reviewed, and revised in a meeting. An IEP is a legal and binding document that all schools should abide by. It explains the child's present level of academic achievement and functional performance; a statement of measurable goals; a listing of any or all special education, related services, and supplementary aids and services that will be provided to

the child or on behalf of the child; and appropriate accommodations that are necessary (ideapartnership.org, 2015).

Individuals with Disabilities Education Act (IDEA). A law ensuring services to children with disabilities throughout the nation. IDEA governs how states and public agencies provide early intervention, special education and related services to more than 6.5 million eligible infants, toddlers, children and youth with disabilities (ed.gov, 2015).

Inference. An idea or conclusion that's drawn from evidence and reasoning. Also known as an educated guess. Some things are learned by experiencing them first-hand, but others are gained by using information that we already know (vocabulary.com, 2015).

Intervention. Strategies, teaching methods and supports that have been shown through one or more valid research studies to help a student improve academic, behavioral/emotional or functional skills (ncpublicschool.gov, 2015).

Main idea. The most important or central thought of a paragraph, or larger section of text, which tells the reader what the text is about (dictionary.com, 2015). It is also the core of the material or the particular point the author is trying to convey. It can be stated in one sentence that condenses specific ideas or details in the passage into a general, all inclusive statement of the author's message (pearsonhighered.com, 2015).

Percentage of Nonoverlapping Data (PND). The most extreme positive baseline data point is identified and a straight line from that point is drawn through the intervention data. The number of intervention data points above the line is divided by the total number of intervention data points (Riley-Tillman & Burns, 2009, p. 109).

Single-case design. Is an evaluation method that can be used to rigorously test the success of an intervention or treatment on a particular case and to also provide evidence about

the general effectiveness of an intervention using a relatively small sample size. Often referred to as single subject design. This design uses visual analysis of data to systematically compare participants' target behaviors before they receive an intervention to the same behaviors during and after the intervention has been introduced. (Riley-Tillman & Burns, 2009).

Traumatic Brain Injury. An acquired injury to the brain (open or closed head injury) caused by external physical force. This will result in total or partial functional disability or psychosocial impairment that affects a student's education. Areas that can be affected are: cognition, language, memory, attention, reasoning, abstract thinking, judgment, problem solving, sensory, perceptual abilities, motor abilities, information processing and speech (isbe.net, 2015).

Trendline. A line on a graph that represents expected student growth over time without the intervention taking place (ritnetwork.org, 2015).

Chapter Summary

Chapter One presented the reasoning for the research that was conducted. Teaching strategies and methods are always guided by the student's needs. Students with ASD can have more difficulty writing notes and assignments by hand because of their inability to use sensory regulation to filter out sights, sounds, smells, and movements around them. This research explored using a Chromebook™ for capturing notes in order to retain more details about a reading passage.

Chapter II

Review of the Literature

Prior to any research beginning, different subjects were reviewed in literature to understand the many parts of research including the student, the intervention that would be used, and educational strategies. Technology in the general and special education classrooms, supporting students with ASD, the affect of ASD on reading comprehension and motor skills, and the role that gender has played in research were the main topics of the literature reviewed for this paper. Each topic explained or supported the main components of the research to be conducted.

Technology in the Classroom

Incorporating technology into the teaching and learning in schools has been an important topic in the last few decades (Lee, Waxman, Michko, & Lin, 2013). "Not only are there many more computers in schools then there were a decade ago, the proportion in classrooms relative to computer laboratories is also increasing" (Lowther, Ross, & Morrison, 2003, p. 23). Lowther et al. (2003) goes on to say society is increasingly recognizing the need for developing computer skills that are applicable to solving real-life problems. Reports that the percent of students using computers at school more than doubled between 1984 and 1997 (Gulek & Demiras, 2005). "*Education Week* also notes that 98% of the nation's schools have Internet access and that more than 12% of the nation's schools have used laptops as an instructional tool" (as cited in Gulek & Demiras, 2005, p. 4). Technology is reshaping how students are able to access information and learn within and outside of their classrooms (Shapley, Sheehan, Maloney, & Caranikas-Walker, 2011). Shapley et al. 2011 says "...lessons supported by technology can involve real-world problems, current and authentic informational resources, virtual tours of remote locations,

simulations of concepts, or interactions with practicing experts and global communities". This shows that students can learn more when they are able to engage in meaningful, relevant, and intellectually exciting work (Shapley et al., 2011). Lee et al. (2013) comments that his research findings had little information about the effective strategies or appropriate approaches to joining together technology and the schools.

Gulek and Demiras (2005, p. 4) state that "38 states' standards for teacher certification include technology, 15 states require technology training or coursework for an initial teacher license, and 9 states require a technology test for an initial teacher license". "There is no doubt that educational leaders are increasingly looking for ways to increase instructional uses of technology" (Gulek & Demiras, 2005, p. 4). This leads to research by Zoch et al. (2013) that although most teachers understand the importance of using technology in their curriculum, they face struggles and barriers due to lack of knowledge or access to technology and the equipment. Lowther et al. (2003) found that even with extensive professional development teachers struggled to use computers in learning. Zoch et al. (2013) developed a course to provide teachers with background information regarding advances in technology influence in literacy practices, supported the teachers while they built their pedagogical knowledge of how digital texts and tools could be used in the classroom, and finally providing them a setting where they could directly implement what they had learned to a group of students. She found that many teachers had plenty of technology accessible but their barriers still remained until this research was conducted. Overall, the teachers were able to shift their teaching to include more technology, take more risks and becoming more creative in integrating technology (Zoch et al., 2013).

Implementing technology into a classroom has its challenges but also comes with its rewards. Knowing what motivates a student, when it comes to technology, can open doors for

the educator that weren't thought possible many years ago. "Motivation gets humans going. Motivation arouses interests. Motivation creates the want to achieve a goal. Teachers are always looking to see what motivates their students. Motivation is the key to academic success as well as promoting lifelong learning" (Granito, 2012, p. 2). Teachers can use technology to motivate their classroom. They can use it as a reward or as a punishment. Depending on how the student reacts to technology. "Reluctant learners are not only reluctant to learn but also reluctant to seek the motivation to learn" (Sanacore, 2008, p. 40). A reluctant learner can be a student on a spectrum of not finishing their assignments all the way to being "content with just getting by" (Granito, 2012, p. 2). Being a reluctant learner can start in elementary school and can linger until high school because of the increase in academic demands as the years progress (Sanacore, 2008). One key to turning a reluctant learner into an inspired one is to "create a learning environment that is encouraging and challenging" (Sanacore, 2008, p. 41-42). Along with "providing students with opportunities to make learning choices, increase students' participation in classroom activities and encourage students to love learning" can change a student's perception of school and learning (Sanacore, 2008, p. 42-43).

Some schools have implemented a one-to-one program, which is a program that provides a take-home laptop computer for each student within a specific grade level of the school system (Sauers & McLeod, 2012). Although these programs are becoming more popular, they are still a new instructional intervention. The benefits and/or drawbacks of such a program are not yet know because of the lack of research. Some research has claimed that the laptops don't have a positive impact on student achievement and some schools have canceled their programs all together (Sauers & McLeod, 2012). One of the positives of the program was when compared to the control group, the laptop group outperformed their peers in literacy responses and analysis, as

well as writing strategies (Sauers & McLeod, 2012). Not only did the student's academics improve but also their behavior. Sauers and McLeod (2012) found students were sent to the office less frequently, were suspended less, and overall were much more satisfied with school. "The biggest changes from baseline to end of year data were seen in increased high student attention, interest, and engagement and a decrease in the use of traditional independent seatwork" (Sauers & McLeod, 2012, p. 4).

All of these authors focused on technology in the general education classrooms. If students in general education could reach success and achieve more, the research for technology in special education would be fascinating to see.

Special Education and Technology

Alexander Graham Bell's invention of the telephone came from his desire to assist people with hearing disabilities while working at a school for the deaf (biography.com, 2015). Bringing technology into a special education classroom can make vast improvements in a student's learning. "The past 20 years have seen an unparalleled interest in the use of instructional and assistive technologies" (Thompson, Bakken, Fulk, & Peterson-Karlan, 2004, p. 2). Accommodations don't lower the expectations or change what is being taught but rather support the student's ability to learn in the classroom and demonstrate their knowledge on assessments by removing obstacles (ed.gov, 2015). Accommodations for students with disabilities has gone beyond letting a child listen to an audio book instead of reading a text. Currently, accommodations can be anything from word processing software and word prediction software to augmentative and alternative communication (AAC) devices which help make is possible for individuals with poor or no speech communicate (Hasselbring & Glaser, 2000). There are multiple devices to assist students with visual and hearing impairments and many devices used to

assist students with physical disabilities. Hasselbring and Glaser (2000) go on to say that those mentioned technologies have continued to grown increasingly more sophisticated and more familiar in the classroom while there are still other technologies being developed for the future. The most common reason for these kinds of accommodations not being used is because inadequate teacher/staff training and the cost. In general the cost of any technology is a serious consideration for the school (Hasselbring & Glaser, 2000). "Today's classrooms are increasingly diverse and teachers need to proactively set-up the environment and instructional methods in ways to support all learners" (Denning & Moody, 2013, p. 6).

According to Harris and Smith (2004), "laptops were credited with improving the engagement of students with disabilities with their school work; increasing their motivation and ability to work independently; and improving their class participation, interaction with other students, interaction with teachers, and class preparation" (p. 1). Their study concluded that "special education teachers perceive laptop computers to be highly effective instructional tools for students with disabilities" (2004, p. 1). Teachers warned to match the laptop characteristics and challenges to the learning styles and frustration levels of the students (Harris & Smith, 2004).

"There is no doubt that technology has the potential to act as an equalizer by freeing many students from their disability in a way that allows them to achieve their true potential" (Hasselbring & Glaser, 2000, p. 118-119). Thompson et al. ends by saying,

> Regular and special educators need to wake up to the fact that matching students with the right technologies and teaching students how to use technologies is an integral component of modern special education services. The technology to improve literacy skills of students receiving special education is here; we just have to use it (2004, p. 14).

Supporting Students with Autism

The term autism was first begin in 1911 to describe a person's exclusion of the outside world and removal from social life (Buehrly, 2005). In the 1950's and 60's the medical community believed autism was an emotional disorder of the result of uncaring mothers (Buehrly, 2005). Autism is not accepted as an abnormality in brain structure or function (Buehrly, 2005). "Doctors have found that the shape and structure of the brain in autistic children differ greatly from those children who are not autistic" (Buehrly, 2005, p. 69).

"The prevalence rate of children with autism spectrum disorder (ASD) has grown more than tenfold in the past two decades and is now estimated at out 1 in 88 children" (Denning & Moody, 2013, p.2). Autism is the third most common developmental disability (Buehrly, 2005). Students with ASD need instructional materials and the use of effective instructional practices for support in the classroom (Denning & Moody, 2013). A concern is that teachers are reluctant to modify instruction in order to meet the needs of all learners (Denning & Moody, 2013). Schedules are a great tool for students with ASD because it provides a visual warning for what is about to come next. This can reduce anxiety and permits the student to prepare for the next activity (Denning & Moody, 2013). Schedules can also highlight a change in the routine and allows time for the student to adapt to the change (Denning & Moody, 2013). Teachers need to be clear and precise about expectations in the classroom. "Procedures should be developed and taught similarly to academic content or behavioral expectations" (Denning & Moody, 2013, p. 7). Denning & Moody (2013) describe effective teaching strategies, such as an advanced organizer, that can help students focus on relevant details because students with ASD may focus on irrelevant or inaccurate information. "Students can also use pictures to words to develop visuals and then use them in multiple settings for the following purposes: (a) completing

homework at home, (b) understanding content in the general classroom, and (c)promoting independence when completing assignments" (Denning & Moody, 2013, p. 10). Carberry (2014) explains that "if schemata are not formed appropriately new information remains fragmented. This perspective of memory could relate to how students have difficulty connecting details to larger parts of information" (p. 21).

Autism and Reading Comprehension

"Due to the interrelationship of literacy skills, students who exhibit difficulties with one element of the language system often exhibit related problems in other areas of literacy. Reading is often considered the most complex element of literacy" (Thompson et al., 2004, p. 4). Thompson et al. (2004) also found that anywhere from 10 to 15 percent of the general K-12 population and the majority of students with IEPs with a have a problem with reading.

Reading comprehension seems to be the area with the greatest difficulty in students with ASD as opposed to word recognition (Ricketts, Jones, Happe, & Charman, 2013). Children with ASD decode words using the same phonological and orthographic mapping process as their non-disabled peers (Randi, Newman, & Grigorenko, 2010). Unlike their classmates, the more abstract skills of reading comprehension don't develop along with the word recognition skills (Randi et al., 2010). "Word recognition and oral language are both important determinants of reading comprehension ability" (Ricketts et al., 2013, p. 2). Ricketts et al. (2013) go on to say that skills in both areas of word recognition and oral language are essential for skilled reading. Reading comprehension may be the result of weak word recognition, oral language, or both (Ricketts et al., 2013). Ricketts et al. (2013) found information from the article *Patterns of Reading Ability in Children with Autism Spectrum Disorder* by Nation, Clarke, Wright, and Williams (2006) that states "there is evidence that reading comprehension correlates with

performance on word recognition and oral language tasks in children and adolescents with ASD" (p. 5). Ricketts et al. (2013) goes on to express that "therefore, impoverished word recognition and oral language comprehension may present barriers to successful reading comprehension in ASD" (p. 5).

Hyperlexia is often seen in individuals with ASD and is noted in research when looking at ASD and reading comprehension. Hyerlexia is described as a "child's precocious ability to read (far above what would be expected at their age), significant difficulty in understanding and using verbal language (or a profound nonverbal learning disability) and significant problems during social interactions" (csld.org, 2007, p. 1). This can lead educators to believe that the student is understanding what they are reading because the student is fluent but until reading comprehension is tested teachers won't know.

Memory dysfunction can also contribute to reading comprehension deficits. Randi et al. (2010) explains how memory and reading comprehension are linked together,

> Connecting sentences together to construct a global understanding requires memory capacity. Although high-functioning children with autism have strengths in rote memory, they have memory impairment due to poor use of organizational strategies, especially when the information is complex and requires the creation of an organizational structure to facilitate memory (p. 6).

This is especially evident when a student is reading a longer text (Randi et al., 2010). In addition to memory discrepancies and poor organizational abilities, ASD students tend to focus on details instead of connecting the sentences together into a logical whole (Randi et al., 2010).

Besides reading comprehension, some researchers have seen "the importance of inferential processes, background knowledge and comprehension monitoring for reading

comprehension, in addition to word recognition and oral language, so that readers can construct a meaning-based representation" (Ricketts et al., 2013, p. 6). Although students with ASD can be shown how to make a generalization from parts of a text to the whole text, they still have difficulty with thinking at the abstract level (Randi et al., 2010).

Reading a narrative story requires the reader to engage cognitive processes to infer character's traits and draw conclusions. This can be difficult for a student with ASD, who typically prefer expository texts because they don't have use abstract thinking (Randi et al., 2010). Narrative texts have readers give their interpretations of characters and problems causing children with autism to be challenged because of their delays in the ability to infer intentions and emotions of others (Randi et al., 2010).

Teachers can apply instructional strategies such as RAP (read, ask, and paraphrase) to help a student with reading comprehension (Denning & Moody, 2013). The three parts of RAP are the students *read* the paragraph, then they *ask* themselves about the main idea and details, and finally, students *paraphrase* the paragraph (Denning & Moody, 2013). As students become more skilled in doing this strategy with one paragraph, they can then move on to longer passages with multiple paragraphs. Other instructional strategies are guided reading, providing visual frameworks, and peer tutoring (Carberry, 2014; Denning & Moody, 2013; Randi et al., 2010).

Autism and Motor Skills

The writing process requires a high level of coordination between different parts of the brain (Oehler, 2013). "A person must activate the areas of the brain that govern motor control and planning, language skills, sensory feedback, problem solving, imitation skills, memory, organization, and proprioception" (Oehler, 2013, p. 2). The brain of a student with ASD will send far fewer neural signals between those parts of the brain (Oehler, 2013). Children with

autism have a difficult time controlling their hands and tend to have very bad handwriting which can frustrate the child (Buehrly, 2005). Students with ASD can have problems with motor control and planning which affects their fine motor muscles that enable them to hold a pencil (Oehler, 2013). "Until recently, medical science believed that ASD affected only those areas of the brain that controlled social interactions, communication, and problem solving" (Oehler, 2013, p. 2). She goes on to explain that "new information has emerged from recent brain research that there are significant differences in the way the entire brain functions" (2013). Inadequate communication between specific areas of the brain has a significant impact on a student's ability to write (Oehler 2013). "The vestibular system allows subjective awareness of body position and movement in space. Vestibular responses of children with ASD are often delayed or abnormal and this plays a significant role" (Song, 2013, p. 2). Abnormalities in vestibular responses and the difficulty to coordinate one's body affects motor skills and coordination (Song, 2013). In 2009, Kennedy Krieger researchers conducted a study to examine handwriting quality in children with ASD. They found that motor skills predicted handwriting deficits in children. In their most recent research in 2010, adolescents with ASD have poor handwriting quality caused by perceptual reasoning. Dr. Bastian states, "While adolescents with autism are more likely to have handwriting problems, there are several techniques available to improve handwriting quality, such as adjusting pencil grip, stabilizing the writing hand with the opposite hand or forming letters more slowly" (Kennedy Krieger Reachers, 2010, p. 1). Children with learning disabilities have errors in more than just handwriting. They have more errors in punctuation and spelling than their non-disabled peers (Buehrly, 2005). All of those factors combined make writing for them very difficult and can become something they will choose to avoid (Buehrly, 2005).

Temple Grandin (2000) explained "I had the worst handwriting in my class. Many autistic children have problems with motor control in their hands. Neat handwriting is sometimes very hard. This can totally frustrate the child" (pg. 17). Grandin suggests "the teacher should let the child use a computer to write. This will cause less frustration and more enjoyment with writing" (as cited in Buehrly, 2005, p.70).

Students who have to work hard to put their words to paper often lose comprehension, fluency and their ideas when they are writing (Thompson et al. 2004). Someone with writing problems may have problems with: copying or finishing work on a printed page, taking notes from oral presentations, and handwriting or writing illegibility (Thompson et al. 2004). Harris and Smith (2004) found that the laptops removed the motor coordination challenge of writing with pen or pencil and allowed them to create work that was easily edited and could look as good as the work of their non-disabled classmates.

Participant's Gender and the Role in Research

"Girls and women make up slightly over half of the people on Earth" (Watkins, 2014, p. 1). Looking at that statement it is surprising that girls "make up for less than half of the participants in many kinds of psychological research" (Watkins, 2014, p. 1). Autism Speaks (2013) points out that ASD "is four to five times more common among boys than girls". "Given that ASD is more common in males than in females, one would expect that the majority of participants with ASD in published studies in psychology journals are males" (Watkins, 2014, p. 2). In 2012, Edwards, Watkins, Lottizadeh, and Poling reported that "of the 1,644 participants whose sex was reported, 8.8% were male" (as cited in Watkins, 2014, p. 3). Watkins suggests that the male: female ratio of 6 in a statistical sense over-represented as participants in intervention studies. For Ricketts, Jones, Happe, and Charman's research (2013) there was a

participant group of 100 adolescents with a diagnosis of ASD. Of the 100 adolescents only, 9 were female. Their research did not have a good pool of females to see the effects of reading comprehension in females with ASD.

Heike Schaumburg focused her research on the development of girl's computer literacy. "One of the goals of introducing computers to the classroom is to support students who are more reluctant to the use of technology. . . Studies have shown that these students are often girls" (Schaumburg, 2001,p. 3). Schaumburg explained the results of her study that the girls in the control group scored consistently lower than boys on almost all of the subtests while the girls in the experimental group scored slightly higher than boys. As a result of the girls showing a higher relative gain then boys, the girls were able to reduce the gender difference and in one case the girls of the laptop group even outperformed the boys. The one area where girls scored than the boys, in both the control and experimental group, was regarding computer confidence. Schaumburg's research shows that a gap between genders can be bridged when the focus is on closing that gap.

Chapter Summary

This review of literature studied 22 articles of research conducted concerning different aspects of education. The articles contained information about technology in classrooms of general and special education, the different attributes of children and adolescents with autism spectrum disorder, students with ASD and their difficulties in reading comprehension and with motor skills, and the gender of participants and the effect it has on research. These articles provided the background information needed to perform the research highlighted in this study.

Chapter III

Methodology

The purpose of this study was to show the effect of using a Chromebook™ along with Chrome OS™ technology on the retention of information for a high school student within a special education program. The approach for this study was a quantitative experimental single case A-B design (Gay, Mills, & Airasian, 2012). Experimental research is research that can test hypotheses to establish cause and effect relationships (Gay, Mills, & Airasian, 2012). At least one independent variable was manipulated to observe the effect on the dependent variables (Gay, Mills, & Airasian, 2012). A-B design shows that a baseline, or preintervention, phase was followed by an intervention phase (Riley-Tillman & Burns, 2009). Data was collected in two phases to make the comparison of before and during the intervention. The research took place over a 6 week period. The A portion was the first 3 weeks of the time period where baseline data was collected. The participant then used a Chromebook™ for the last 3 weeks to take notes and complete assignments and intervention data was collected.

Participants

The high school where the pool of participants was from is located in the south suburbs of Chicago with a total enrollment of 2,811 students (chicagotribune.com, 2014). 14% percent of the total student population has an IEP or 504 plan (hfhighschool.org, 2015). 23% of students are Caucasian and 67% are African American (chicagotribune.com, 2014). A group of students from the Life Skills Extended School Year Program (ESY) was looked at for this research topic. Being a single case design, a student was selected from the class of 18 students per the recommendation of the classroom special education teacher. These students have various disabilities such as: Down's Syndrome, Autism Spectrum Disorder, Traumatic Brain Injury and

cognitive disability. There were 10 girls and 8 boys in the program. 12 of the students are African American and 6 of the students are Caucasian. All of the students are receiving various support services along with the accommodations stated in their IEP. There is 1 main special education teacher in the classroom along with 1 classroom teacher's assistant and 3 one: one instructional assistants.

Instrumentation

"Bring the Classics to Life" series books was the curriculum used in the classroom. The teacher had chosen to read *Black Beauty* from this series. This series is published by EDCON and the story is adapted by Jacqueline Nightingale. The books have been measured by the Fry Readability Formula, includes 100 comprehension questions that test for main idea, critical thinking, inference, recalling details, sequencing and more, has 60 vocabulary exercises in modified CLOZE format, and defines and uses words in context with new vocabulary prior to each chapter (EDCON, 2015). The two assessments that follow each chapter are a comprehension check and vocabulary check. These were only available as a worksheet and were not accessible online. Each comprehension check worksheet consists of 10 multiple choice questions containing 7 content questions, 2 inference questions, and 1 main idea question that is to be filled out with a pencil.

Procedure

The research was broken down into two phases for the 6 week period that data was collected. The targeted student would complete classroom assignments as they would normally occur with the exception of the final 3 weeks. The last 3 weeks the student used a Chromebook™ to record his/her notes for class. The student would complete the assessment at

the end of each chapter with a pencil and technology would not be involved for entire 6 weeks. The assessment was only available in paper form.

Phase One: Baseline

The first 3 weeks of data collection, the targeted student wrote all of the notes and class assignments with pencil and paper that went along with *Black Beauty's* Chapter 1 through Chapter 5. The student wrote his/her notes stating the main idea, new characters presented, the problem, any supporting details, and the conclusion for each chapter. Each of the new vocabulary words that were presented at the beginning of the chapter were written out and used to make a sentence. For each word, the student also went on the internet and found a picture that would be an example of that word. These pictures were then printed out, cut, and pasted to the paper by their vocabulary sentences. At the end of the chapter, the student completed the comprehensive worksheet using the paper worksheet and a pencil. This worksheet consisted of 10 questions focusing on the main idea and other fine points about the chapter or the characters.

Phase Two: Intervention

Subsequently, the next 3 weeks the student typed all of their notes and completed class assignments on a Chromebook™ for *Black Beauty's* Chapter 6 through Chapter 10. The student used Google Docs to type notes in the same format as before the intervention. Google Docs was also used to type out sentences and to attach a picture to describe or give an example of each vocabulary word. Similarly as in the first 3 weeks, the student completed the comprehensive worksheet after each chapter for Chapter 6 through 10 with a pencil and the paper worksheet.

Data Collection

At the conclusion of each chapter the student completed a 10 question assessment about the chapter that was just read. The researcher then took those answers and compared them to the

answer key in the back of the book (see Appendix B). Following the symbol key at the bottom of the answer key, the researcher knew which questions were content questions, which were inference questions and which question pertained to the main idea. Each chapter had a total number of content, inference and main idea questions that were correct. All of the correct answers were plotted on a line graph to show pre-intervention and during the intervention results for the three question types.

Data Analysis

All of the correct answers were plotted on a line graph in an Excel sheet to show before and during the intervention. The graph illustrates the movement throughout the 10 chapters for each category. The three categories of questions were displayed in three different graphs. Each graph also has a trendline, in a different color, to show where the student's potential could have been if no intervention took place.

Chapter Summary

The intervention of using a Chromebook™ to complete supplementary assignments to go along with chapter assessments took place over a 3 week period. Prior to the intervention the researcher gathered baseline data for 3 weeks using the same assignments and assessments and the participant only used a paper and pencil for note taking. Each assessment was graded and all of the results were graphed to compare all 6 weeks.

Chapter IV

Results

The purpose of this research was to see the effectiveness of using technology for note taking on the retention of information. The approach for this study was a quantitative experimental single case A-B design (Gay, Mills, & Airasian, 2012) to gain information from one specific student and see the affect on reading comprehension retention when a Chromebook™ was used to take notes and complete class assignments. The benefit of the treatment is determined by comparing the pre-intervention results to the results gathered during the intervention.

Demographics

It was brought to the researcher's attention by the classroom teacher that one student from the class of 18 was struggling more than the other students. The student being observed for this study was a Caucasian, 17 year old female who has been classified as being on the Autism Spectrum and having a Cognitive Disability. This student was placed in the ESY program as part of her Life Skills program requirements within her high school.

The Effectiveness of Chromebook™ on Content Retention

The research question asked: Do students with poor hand writing skills retain more information when using a Chromebook™ while taking notes? Figure 1 shows the increase in content knowledge. This area had the most significant increase during the intervention. She went from an average score of 3.4 to 5.8 correct content questions. The trendline shows the she would have received 4 correct answers by the end of the 6 weeks. Her score would have only increased by approximately 9%.

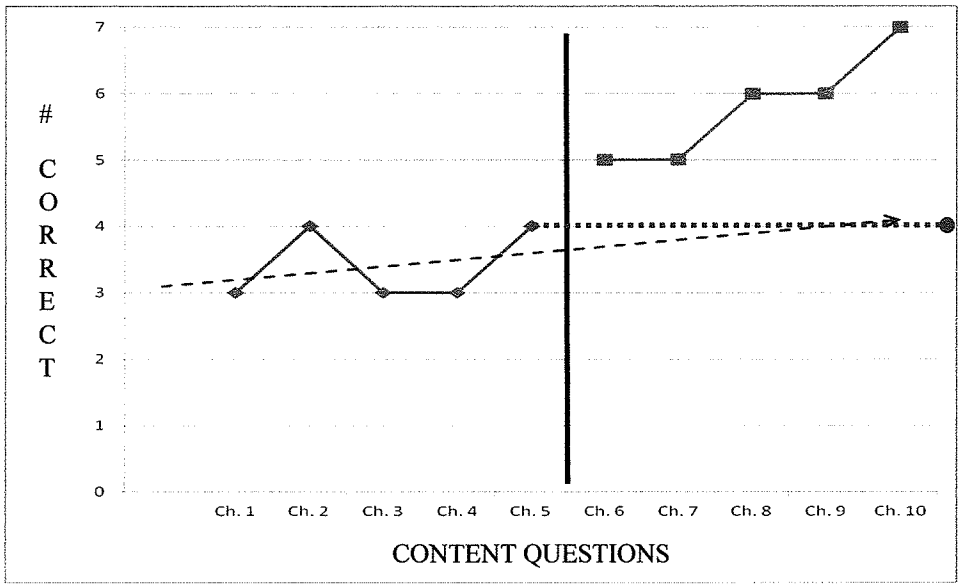

Figure 1. Student performance on content questions during baseline (Chapter 1-5) and Chromebook intervention (Chapter 6-10). Each chapter had 7 questions.

A total of 25% above the trendline is where she averaged when using technology to complete her assignments and take notes. The green dashed line in Figure 1 shows the highest point in the baseline data and all of the points in the intervention portion are above this line. Her PND for content is 100%.

The Success of Technology on Main Idea Retention

Each chapter in *Black Beauty* had one question about the main idea so only one opportunity to show that she understood the main idea. The question asked the student what the story was mainly about. Depending on the title of the chapter and the information given she might have seen more than one answer being correct.

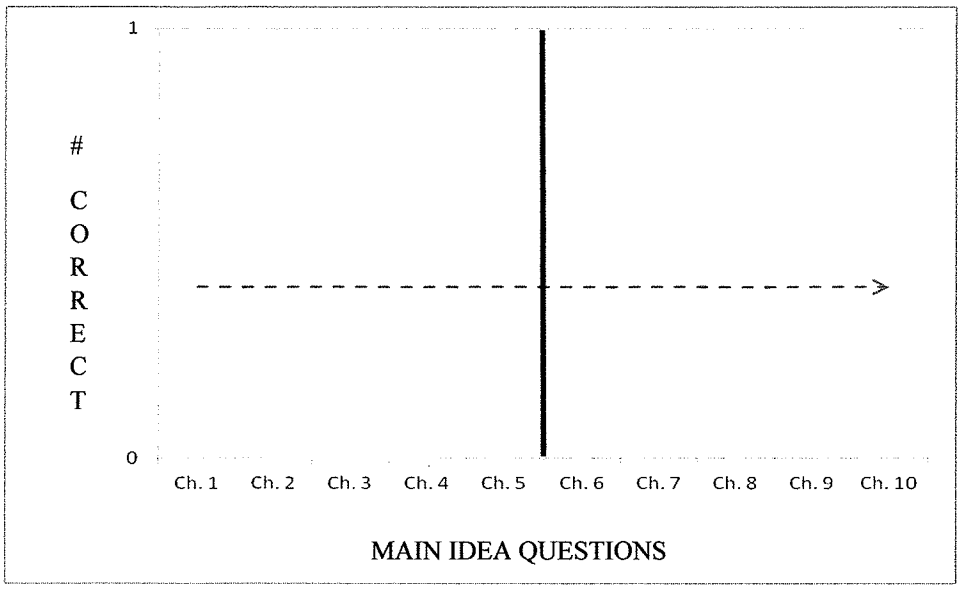

Figure 2. Student performance on main idea question during baseline (Chapter 1-5) and Chromebook intervention (Chapter 6-10). There was only one question for each of the chapters.

From the student's results she didn't choose the best answer for that question on an average of 40% before the intervention. During the intervention she chose the correct main idea answer 60% of the time. The trendline shows that if there had been no new strategy implemented she wouldn't have gotten any of the questions correct.

Improvement on a Student's Abilty to Infer About a Short Reading Passage

Inference can be a difficult concept for a student with or without a disability. Those questions are asking the student to apply what they already know or have learned to make a logical conclusion (study.com, 2015). Every chapter in the series had one question asking the student "Another name for this story could be" with four multiple choice answers. There were always two answers that did not pertain to the current chapter. The other two answers could both be correct but one of them was the best answer. A few times the student picked the first correct answer she saw instead of looking at all the answers before making a choice. Her test taking skill is an area that could be reviewed for any deficiencies and taken in account for her poor scores.

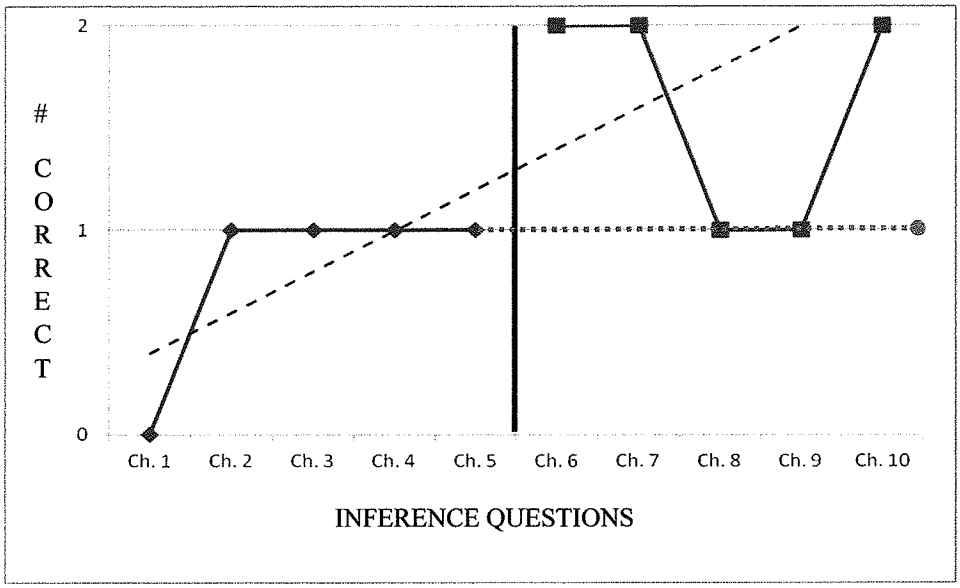

Figure 3. Student performance on inference questions during baseline (Chapter 1-5) at one per week and Chromebook intervention (Chapter 6-10) with a possible score of 2 correct.

Similarly as with the content questions, the PND for inference was also looked at. The PND for Figure 3 is 60%. Riley-Tillman and Burns state that a recommended PND of at least 80% for large effect is ideal but they later argued that even if all intervention points are above the highest baseline point there can still be a discrepancy when looking at how much room is between the results and the highest baseline point. All of the points could be above the line and show a PND of 100% but some points could be higher than others and truly show more growth than the PND. Overall she achieved 80% correct answers in the last 3 weeks compared to 40% correct during the first 3 weeks.

Chapter Summary

The purpose of this study was to determine if using a Chromebook™ to take notes and complete assignments in class would improve the retention of reading comprehension information. One student was selected and participated in this study for a period of six weeks. A quantitative experimental single case A-B design was conducted for this project. Data was gathered at the end of each chapter and then plotted on a graph to compare before and during the

intervention. The significant improvement in content knowledge indicated that the hypothesis is supported. Therefore, it can be said that a student who struggles with handwriting can gather and retain more information when they are using a Chromebook™ to type their notes and to complete classroom work.

Chapter V

Discussion and Conclusion

Computers and other forms of technology have become more evident in education and everyday life. This has resulted in teachers changing how they approach instruction. Some research focused on professional development to lessen the variable of teachers not being proficient with technology for the reason that technology was not used in their classrooms. Mostly, technology has innovated the way struggling writers are able to produce better quality and lengthener work. In addition, technology helps students with ASD improve in reading comprehension as seen in this research study.

Discussion

The literature that was reviewed covered the topics of technology in general and special education classrooms, supporting students with autism, autism and reading comprehension, autism and motor skills, and finally participants gender and the role in research.

Technology in General and Special Education

Within the school, where this research took place, there were multiple computer labs and other forms of technology available to the teachers and students. Teachers used iPads to take attendance, the students used Chromebooks™ to take notes, and all of the schools announcements are broadcasted on the school television channel. Every classroom has a SMARTboard and a few desktop computers or a classroom set of Chromebooks™. Technology is becoming more common within schools and the teachers are using it as much as they can. During the ESY program the teacher was able to pull up Google Earth and show the students where other countries were and what they looked like.

Even though technology is becoming more common in the schools, the teachers need to continue to find creative ways to use it. Teachers should expand the way that they teach so that all of the students have a chance to learn as much as they can. For some students, technology is the tool that can help them achieve that.

Supporting Students with Autism

Each student learns differently in general and special education classrooms. Some students need more support than others. Students with ASD are a good example of how each student is different. A teacher can have a classroom of 10 students all with the classification of ASD and each one of them requires different things. Some students may need visual aids, some with will need a break from the stimulus in the classroom, while another may need extra time to complete an assignment. Supporting students in the classroom can be the most challenging aspect of teaching. Determining what will help their students the most is the most common reason teachers teach. Teachers want all of their students to succeed.

Autism and Reading Comprehension

The research and literature showed that there are many parts to reading and writing. A student with ASD who can read fluently does not necessarily understand what they are reading. A teacher could be under the impression that their student is comprehending but test scores would show that's not the case. Abstract skills don't develop in a student with ASD even though their word recognition skills are present. Hyperlexia is more common in students with ASD and can attest to why a student can read above grade level but not comprehend the passage. The student involved in this research had above grade level in word recognition but her reading comprehension skills were lacking.

Autism and Motor Skills

Understanding that hand writing is more than just putting pencil to paper can help a teacher look past poor hand writing. Some teachers see poor hand writing as a student trying to rush through their assignments or not caring about what they are doing. The brain of a student with ASD sends fewer neural signals between the parts of their brain that govern motor control. Inadequate communication between those parts results in poor hand writing. Allowing a student with poor hand writing to use technology to type notes or complete assignments can have a positive impact. Those students are able to type more information than they would be able to write. The more notes or assignments they can complete, the more a teacher can see if there are any other areas that they are struggling in. This research saw the student improve on her comprehension with the help of using technology.

Participant's Gender and the Role in Research

ASD is more common in males than in females. Female students are also more likely to be reluctant to use technology. In this study a female student with ASD was provided with a Chromebook™ to take her notes and complete her assignments. In the pool of students with ASD, there was only one female student. She was also the student with the most illegible hand writing from the group of students with ASD. Unlike in other studies where the pool of participants had a large group of females

Conclusion

The assignments completed and notes taken over the 6 weeks of research became more detailed and thorough. When the student was able to use the Chromebook™ to type her notes, she could spend more time typing her information and gathering more details from the chapter. In doing so, she retained additional facts about the story and answered more questions correctly.

Each chapter had three areas of literacy questions. This research focused on improving reading comprehension. The other two areas, main idea and inference, improved as well but other strategies would need to be implemented to see more growth.

Educational Implications

More research should be conducted for students with ASD and other ways to improve their reading comprehension. More information is needed concerning hyperlexia and the effects on students with ASD. Teachers should be informed about hyperlexia, its effect on student's performance, and the strategies they can use to overcome it. Students with poor hand writing, in general and special education, should use technology as a way to remove some of the stress of writing. Technology has been shown to improve reading comprehension, so there are possibilities for improvement in other subjects as well.

Recommendations for Further Research

Further research should be conducted similar to this research but with male participants using technology. As well as assessing the retention of the content from the entire story. At the conclusion of the 6 weeks, the student didn't complete an assessment of all 10 chapters of the story. A complete assessment of the book at the conclusion of the research would show what, if any, information had been retained for more than the week that the student was reading that chapter. This could present information concerning short and long term memory in students with ASD and using technology.

Summary

Teaching strategies and methods are guided by what students need. Students with ASD can have more difficulty writing notes and assignments by hand. Technology has its benefits, as well as its disadvantages, in education. The purpose of this study was to determine if using

technology to take notes and complete assignments would improve reading comprehension. The significant improvement in content knowledge supported that hypothesis. Therefore, it can be said that a student who struggles with hand writing can gather and retain more details and information when using technology to type their notes and classroom work.

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Appendix B

	Question number										Totl Cont	Totl MI	Totl Inf
	1	2	3	4	5	6	7	8	9	10			
Ch 1 Answer Key	C	D	A	C	B	C	D	A	A	B			
Ch 1 Student	C	B	B	A	B	D	C	B	B	B	3	1	0
Ch 2 Answer Key	A	D	C	D	A	B	D	A	A	C			
Ch 2 Student	A	B	B	D	B	B	D	B	B	D	4	0	1
Ch 3 Answer Key	C	A	B	B	A	D	B	D	A	B			
Ch 3 Student	C	B	B	B	A	C	C	C	B	B	3	1	1
Ch 4 Answer Key	A	D	B	C	B	D	A	B	C	A			
Ch 4 Student	B	D	C	C	B	D	B	C	B	B	3	0	1
Ch 5 Answer Key	D	C	B	D	A	B	A	D	D	B			
Ch 5 Student	D	C	B	B	A	B	C	C	A	B	4	1	1
Ch 6 Answer Key	C	C	B	D	A	B	A	D	C	A			
Ch 6 Student	C	C	B	D	A	B	C	C	C	B	5	0	2
Ch 7 Answer Key	B	A	A	B	C	A	D	A	C	D			
Ch 7 Student	B	B	A	B	C	A	D	B	C	D	5	1	2
Ch 8 Answer Key	D	C	B	A	B	D	D	C	B	A			
Ch 8 Student	D	C	B	B	B	C	D	C	B	C	6	0	1
Ch 9 Answer Key	A	D	C	B	A	A	A	B	D	D			
Ch 9 Student	A	D	C	A	A	A	A	B	C	D	6	1	1
Ch 10 Answer Key	B	B	A	A	D	B	C	D	C	D			
Ch 10 Student	B	B	A	A	D	B	C	D	C	D	7	1	2